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TEACHING SCIENCE WITH MIND MAPPING INSTRUCTIONAL STRATEGY IN TERTIARY INSTITUTION

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ABSTRACT

Mind mapping has been considered a non-linear approach in a classroom environment which is encouraging the students to think and explore different concepts of the subject matter by using the visual special relationship of different components of the topic to frame a central theme and create branches from the theme which are interrelated. The study has been conducted to find the importance of using the graphical tool to improve the learning experience of students in the science classroom in secondary education. The qualitative data has been collected by using secondary resources. A non-probability sampling technique purposive sampling has been used to conduct the research. The data analysis has been performed by using a widely used approach by researcher thematic analysis. The result has discussed in the periphery of three domains that mind mapping is effective for improving cognitive processes, critical thinking, and high-order thinking skills, elevating the quality of teaching strategy by educators and improving the problem-solving ability of students. It has been found that the use of mind maps in STEM education has gained significant attention from educators. The lack of proper teacher training facilities for using ICT-enabled mind map software is a gap that is restricting the use of ICT in classrooms. Improving the quality of teacher training and providing necessary facilities by the school authorities is recommended to mitigate this problem. It is expected that the result of the report will provide the necessary support to future researchers in the field of education to get insights into the research topic.

KEYWORDS: STEM Education, Cognitive Processes, Problem-Solving Ability, ICT, Intelligent Tutoring Systems, Collaborative Learning

1. INTRODUCTION

Mind mapping is a technique educators use in schools and higher educational institutions to represent verbal and conceptual information to students (Schroeder et al. 2018). A concept map on a mind map is represented by a diagram in which the educator establishes a relationship between the identified factors of a particular topic. Mind map includes a large number of links and nodes beard with each other to establish relationships. This has been reported that the use of mind maps was found to be effective to improve the performance of STEM education in secondary education (Holmlund *et al.* 2018). The study's objective is to find the importance of mind mapping for teaching science as an instructional strategy in secondary education. In the perspective of the utilisation of the mind mapping there is the presence of multi-sensory tools which is helpful in the integration, organisation and retention of the information. This is done with the presentation through a diagram in a systematic and structural manner over the outlining of information (Zhao *et al.* 2022). In the approach of teaching science in tertiary educational institutions there is the array of large brainstorming web which centres out from a specific fact or factual in the scientific aspect.

2. REVIEW OF LITERATURE

Mind map as a tool of ***"intelligent tutoring systems"***

Rote learning is strongly discouraged in the present education system. Educators have to play an important role to support students by providing interactive tools to understand the concept of the topic in classrooms. According to Hillmayr *et al.* (2020), ***"intelligent tutoring systems"*** is allowing the individual adaptation to the difficulty of the task and pace to represent the content according to the learner's need. In addition, it also provides differentiated feedback for the optimisation of the learning process. Mind maps can be used as an ***"intelligent tutoring system"*** for minimising the burden of road learning among students.

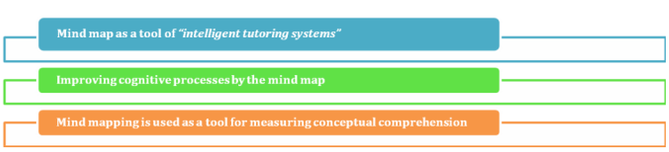

Figure 1: Use of mind map in three domains (Source: self-developed)

Improving cognitive processes by the mind map

Cognition deals with the mental activities found in our brain to process incoming stimuli and retain information to be used later. The use of a mind map as an instructional strategy in secondary education is an effective method to understand the connections between the information and the concept of a science topic with the existing knowledge of a student by breaking down the information into different nodes. According to Weinstein *et al.* (2018), mind mapping is an illustration of the retrieval practice that improves the retention of information from long term memory into working memory. Thus, it improves the cognitive process of students.

Mind mapping is used as a tool for measuring conceptual comprehension

According to Almulla and Alamri (2021), conceptual comprehension can be measured by using mind mapping quantitatively and quantitatively which makes it a useful tool to supplement the traditional pen-and-paper assessment. It is mentioned that prospective teachers are using mind mapping in the instructional strategy in the classroom to unearth understanding in education by facilitating collaborative learning.

Brainstorming and mind mapping

The prospect of brainstorming and concept mapping had been done on the basis of a central focus of a specific idea and then the mapping is applied for formatting the desired outcomes. This is a very imminent decision-making tool which is associated with creation of a visually creative matter through exploration of knowledges, application of critical thinking skills and summarisation of key concepts (Su and Zou, 2022). In the science education of tertiary sector there has been the applicability of visual-spatial relationship which originates from a central theme and flows down to peripheral branches which can be inter-related and thus the highest order of education is being imparted to the learners.

3. MATERIALS AND METHODOLOGY

Secondary data collection has been used to collect the data for the study. Secondary data refers to the data that has been already published in different journals and articles by primary researchers which have been used to conduct the study (Martins *et al.* 2018). The use of secondary data provides the necessary advantages to the researcher like cost-effectiveness. The time required for the research was not sufficient for primary data collection which is overcome by using a secondary data collection process. The secondary data was collected from the various journals, article and reviews from the scholarly publications in the Google Scholar. At first a total of twenty-five journals and articles had been taken and from them five journals had been taken for the research purpose by applying a non-probability sampling method. Then the related themes from the identified concepts from those journals and articles had ben applied. The generalisation of the identified data had been done in a theoretical approach for the analysis and discussions of those data. Thematic analysis of quality data means the researcher will find a similar pattern of information from the collected resources to prepare a theme relating to the research topic (Kiger and Varpio, 2020). Purposive sampling is a non-probability sampling method which has been used in the study (Langer, 2018). It is a sampling technique that refers and the process by which researchers are selecting the samples which have the desired characteristics

4.RESULTS AND DISCUSSION

Mind map improved cognitive process

It has been reported that the use of proper mind mapping techniques in the learning strategy has been found to be efficacious to improve the achieved scores of students in a topic of physics and chemistry that is inorganic qualitative analysis (Bouabdallah, 2021). The result is showing that the use of the mind mapping tools like that of Coggle for beginners' usage, Mind Meister for collaboration on a mind map with a team, Ayoa for mind mapping through

modern approaches and X-mind for the personal brainstorming in mind mapping has been the main inhibitors for proper organisation and representation of inorganic qualitative analysis in improving the performance of students.

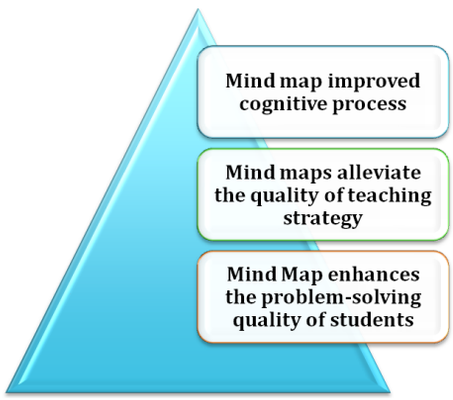

Figure 2: Results of research (Source: self-developed)

Mind maps alleviate the quality of teaching strategy

It has been reported that mind mapping strategies based on the direct utilisation of the technologies like that of paper-based mind maps (PB-MM) and digital mind maps (D-MM) plays a considerable role in improving the quality of teaching in science and mathematics education (Hillmayr *et al.* 2020). In this D-MM can be ascertained as the most advantageous form as this includes the utilisation of the multimedia which gives pictorial expression of the mind-mapping aspects. Using mind map software in classrooms by educators can be a potential factor for enhancing the student learning experience. Another highlight is that the provision of teacher training is also reported to the impact of using mind maps on the performance of students.

Mind Map enhances the problem-solving quality of students

The problem-solving ability of students is considered a higher-order thinking skill that has a significant influence on the improvement of performance in the scholastic area. It has been reported that the use of a mind mapping-based problem-solving approach in the classroom is a strong body related to enhancing the learning performance of students that includes the ***"critical thinking tendency and problem-solving quality"*** (Hwang *et al.* 2021).

Enhancement of creativity and innovative approaches through mind mapping

By the application of the mind mapping strategy this can be ascertained that innovative and creative approaches have been developed in a systematic way through the application of centrally focused theme in a systematic manner (Smyth *et al.* 2022). The visually outlined information gives a varied version of the application of several new themes which provides the learners a new phase of enhancement in their cognitive skills helping in enhancement of their innovative perspectives in practical usability.

5. CONCLUSION AND FUTURE SCOPE

Thus, it can be concluded from the study that mind mapping is an effective technique that should be properly utilised by educators in the classroom for improving the teaching instructional strategy. It has been found from the result that the cognitive process of students like critical thinking and higher other thinking skills along with problem-solving ability is improved by using this graphical tool. Using different mind map software by educators requires proper training that should also be properly monitored by the school authorities to make the learning experience better for students. Science teaching in classrooms requires proper technology support that is playing a considerable role in upgrading the teaching strategy to improve the learning experience. In this peripheral this can be identified or observed that the utilisation of the mind mapping becomes more feasible through utilisation of technologies rather doing them in the conventional ways. There is the mentioning of the usage of the D-MM or digital mind maps which can help in the development of the cognitive approaches of the learner process to understand their possibilities or weaknesses in their approaches thus helping in suitable amendments of their practices.

6. RECOMMENDATIONS

During the research, one report highlighted the profession of teacher training to use the technology-supported instructions like mind map software to improve the learning experience of learners in the classroom. The lack of proper teacher training facilities in different schools is a potential factor that is restricting the use of these graphical tools in the classroom environment. The recommendation is that this is the responsibility of the school authority to provide necessary training facilities to the teachers of schools for gaining insights into using the upcoming new innovative ICT strategies to create mind maps that are attractive and effective for students in science classrooms.

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